

EPA COMMENTS ON DRAFT TECHNICAL MEMORANDUM #2  
OPERABLE UNIT 3 (OU-3) EXPOSURE SCENARIOS

Section 3

General:

1. The reasonable maximum exposure (RME) scenario is a combination of three elements: (1) land use assumption, (2) exposure pathway combinations, and (3) exposure pathway equation parameters that are an appropriate mix of values that reflect averages and 95th percentile values. The discussion of future land use in Technical Memorandum 2 includes a number of different land use scenarios but it is not clear if the RME is a combination of scenarios reflecting different development patterns for distinct parcels of land or if it is DOE's intention to assume one RME scenario across the entire study area. This must be clarified. The consideration of the use of all environmental media (soil, water, sediment, air) on OU-3 should be consistent with the definition of the RME. This is critical because the RME is a basis for the remedial action (or no action) decision (see OSWER Directive 9355.0-30).
2. The discussion of land uses of IHSSs 200-202 should focus on the use of the water as a resource. The likelihood of use of site water as a drinking water supply is a central question in the risk assessment. The beneficial use of the water should be determined as well. The text of Technical Memorandum 2 focuses instead on the land surrounding these IHSSs. This should be modified by discussing the water as a resource, its potential uses, and the use associated with the RME exposure scenario. The discussion of the future use of Great Western Reservoir should include consideration of the use of the water in the event the reservoir is not permitted to dry up. Since the land surrounding GWR is likely to be used for recreation or open space, will the water be used in some compatible manner (i.e., boating, fishing, swimming)?

Specific:

1. The following inconsistencies between the text and the figures in Section 3 should be corrected:
  - a. On figure 3-5, the Walnut Creek drainage east of Great Western Reservoir is shown as commercial/industrial. The text on page 24 states that residential development is projected to increase in this area.
  - b. There is no indication of the Jefferson County Airport on figure 3-5 yet the text doesn't mention that the airport will no longer be there.

c. The area south of Church Ditch on the west side of Standley Lake is shown in figure 3-4 as currently developed for residential use. Figure 3-5 indicates that future use will be for parks and open space. This is inconsistent with the plans for development of Standley Lake by the Standley Lake Task Force.

2. Pages 16,17, and 18 of 30. Sections 3.1.2.4., 3.1.3.4, and 3.1.4.4. It is noted in these sections that water from Mower Reservoir, Standley Lake, and Great Western Reservoir is being used for irrigation of crops used for cattle grazing and horse boarding. Alfalfa, wheat, barley, corn, and oats are also being produced in this area for consumption. If water is being directly drawn from these sources and used for irrigation purposes, contaminants could be taken up into plants and humans could be exposed either through direct ingestion of crops, or ingestion of dairy products or meat. Although it is noted that the water from these sources meets federal and state drinking water standards, the information is irrelevant in a risk assessment. Because radionuclides and heavy metals are sequestered in sediments, surface water sampling should duplicate the conditions of possible exposures. This will likely involve the resuspension of contaminated sediments.

3. Page 17 of 30. Section 3.1.3. It is noted in these sections that many recreational activities take place at Standley Lake. The risk assessment must include ingestion of locally caught fish as well as ingestion of surface water and sediment while swimming, and dermal contact with surface water and sediment.

#### Section 4

##### General:

1. Exposure pathways were eliminated from further consideration without adequate justification. As an example, the justification provided for the exclusion of ingestion of leafy vegetables is contradictory. On page 10, it is acknowledged that this pathway contributed the greatest risk in a residential exposure scenario according to the Past Remedy Report. This indicates the importance of reassessing the risk using OU-3 Remedial Investigation (RI) data. As another example, the results of the Historical Information Summary and Preliminary Health Risk Assessment Report (HISPHRA) are not considered to be adequate justification primarily because this document only considered exposure to plutonium. The OU-3 RI program includes sampling and analysis for TAL metals, a limited number of pesticides, volatiles, uranium, and americium in surface water and sediment. These substances differ from plutonium in key physical and chemical parameters. Therefore, the HISPHRA is not adequate justification for eliminating exposure pathways.

2. The elimination of exposure pathways from consideration based on a comparison of non-RI data to potential ARARs (e.g., discussion on page 18 regarding the ingestion of surface water) is inconsistent with the National Contingency Plan. The

preamble on page 8709 states, "The identification of ARARs is not the purpose of the baseline risk assessment...The identification of ARARs is a separate part of the RI, because many ARARs are not directly risk related... ARARs generally do not provide an adequate basis on which to determine site risks, which are complex and often cannot be reduced to a single number....because these standards are established on a national basis, they may not adequately consider the site specific contamination or the cumulative affect of the presence of multiple exposure pathways and, therefore, are not the sole determinant of protectiveness."

Specific:

1. Page 7 of 37. Section 4.4.1. Ingestion of homegrown fruits, vegetables and beef should be included in the risk assessment for several reasons. First, as is noted in the discussion of land use, considerable areas in OU3 are not only zoned agricultural, but are currently being used for this purpose. Crop production and grazing are the main activities. Moreover, the area is being irrigated for crop production with surface water from OU3, which may or may not be contaminated. Second, reference to "limited use" of home gardens indicates that residents are currently ingesting homegrown vegetables, suggesting this is a complete pathway. Third, although it is correct that radionuclides are not readily taken up by plants, heavy metals are. For these reasons, these pathways should be included in the risk assessment and at least qualitatively discussed.
2. Page 23 of 37. Section 4.4.4. The rationale presented for not considering the exposure of office workers quantitatively is unacceptable and is inconsistent with previous Rocky Flats human health technical memoranda for OU-1 and OU-2. Furthermore, it conflicts with EPA guidance in OSWER Directive 9285.6-03, Human Health Evaluation Manual Supplemental Guidance: "Standard Default Exposure Factors". The exposure of future office workers to contaminants within OU-3 must be quantitatively evaluated.
3. Include the following exposure pathways in the quantitative baseline risk assessment for OU3:

Residential Scenario:

- Ingestion of homegrown fruits
- Ingestion of leafy vegetables
- Ingestion of homegrown meat products
- \* Dermal contact with surface water and sediment
- Ingestion of surface water
- Ingestion of surface water while swimming
- Ingestion of sediment while swimming
- Ingestion of locally caught fish

Recreational Scenario:

Ingestion of surface water  
\* Dermal contact with surface water  
\* Dermal contact with sediment  
Ingestion of sediment while swimming  
Ingestion of locally caught fish

Commercial/Industrial Scenario (office worker) :

Inhalation of particulates  
Soil ingestion

\* Pathways may be assessed qualitatively. Although they are complete, it is likely that relative to other pathways, they present low risk.

The appropriate exposure equation parameters are contained in the attached tables.

Section 5

1. Table 5-1, Inhalation of Particulates, Residential Scenario. An inhalation rate of 0.83 cubic meter/hour (cu m/hr) is used as the reasonable maximum exposure (RME) inhalation rate for adults. However, 1.25 cu m/hr is the upper bound value. Use of a deposition factor is inappropriate.
2. Tables 5-2 and 5-3, Soil Ingestion, Residential and Commercial/Industrial Scenario. A matrix effect factor should not be used unless site-specific information is available. The averaging time for non-carcinogens should be equal to the exposure duration.
3. Table 5-4, Particulate Inhalation, Construction Worker. An inhalation rate of 1.67 cu m/hr should be used. The noncarcinogenic averaging time of 25 years should be changed to 1 year. The use of a deposition factor is inappropriate for the commercial worker. Deposition factors are taken into account during the development of the RfC or inhalation slope factor when pharmacokinetic data is present.
4. Table 5-5, Soil Ingestion, Recreational Scenario. The soil ingestion rate of 25 milligram/event (mg/event) for children and 50 mg/event for adults should be changed to 200 and 100 milligram/day (mg/day) for children and adults, respectively. The matrix effect factor should be eliminated. The exposure frequency listed in the table should be changed to 100 days/year. The exposure duration should be 30 years. The noncarcinogenic averaging time should be 30 years.

5. Table 5-6, Ingestion of Sediments, Recreational Scenario. Ingestion of sediments should be included along with surface water. The matrix effect factor should be deleted from the analysis. An exposure duration of 30 years should be used. Exposure via ingestion of sediments should also be quantified for adults to be consistent with the rest of the recreational scenarios.
6. Table 5-7, Ingestion of Surface Water, Recreational Scenario. An exposure frequency of 7 events/year should be used. The exposure duration should be 30 years.
7. Table 5-8, Inhalation of Particulates, Recreational Scenario. It is unnecessary to evaluate children separately. An exposure time of 3 hours/day should be used. An exposure frequency of 100 days/year should be used. A deposition factor should not be included.

TABLE 3-5  
ROCKY FLATS PLANT  
RISK ASSESSMENT TEMPLATE  
EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
RESIDENTIAL EXPOSURE: ~~GROUND~~ WATER INGESTION  
SURFACE

Intake (mg/kg-day) = $\frac{C \times IR \times EF \times ED}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration (mg/L)	Site specific	Site specific
IR	= Ingestion rate (L/day) <sup>(1)</sup>	2	1.4
EF	= Exposure frequency (days/year) <sup>(1)</sup>	350	290
ED	= Exposure duration (years) <sup>(1)</sup>	30	9
BW	= Body weight (kg) <sup>(1)</sup>	70	70
AT	= Averaging time (days) <sup>(1)</sup>		
	Noncarcinogenic	10,950	3,285
	Carcinogenic	25,550	25,550

<sup>(1)</sup> EPA, 1991b

TABLE 3-8  
 ROCKY FLATS PLANT  
 RISK ASSESSMENT TEMPLATE  
 EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
 RESIDENTIAL EXPOSURE: INGESTION OF HOMEGROWN VEGETABLES

Intake (mg/kg-day) = $\frac{C \times IR \times FI \times EF \times ED \times CF}{BW \times AT}$				
Parameter			RME	AVG
C	=	Chemical concentration (mg/kg)	Site specific	Site specific
IR	=	Ingestion rate, vegetables (mg/day) <sup>(1)</sup>	2.0x10 <sup>5</sup>	2.0x10 <sup>5</sup>
FI	=	Fraction ingested from contaminated source	0.4	0.25
EF	=	Exposure frequency (days/year) <sup>(2)</sup>	350	290
ED	=	Exposure duration (years) <sup>(2)</sup>	30	9
CF	=	Conversion factor (kg/mg)	10 <sup>-6</sup>	10 <sup>-6</sup>
BW	=	Body weight (kg) <sup>(2)</sup>	70	70
AT	=	Averaging time (days) <sup>(2)</sup>		
		Noncarcinogenic	10,950	3,285
		Carcinogenic	25,550	25,550

<sup>(1)</sup> This ingestion rate is based on the typical consumption value of fruits and vegetables (200,000 mg/day), with the "reasonable worst case" proportion that is assumed homegrown (EPA, 1991b).

<sup>(2)</sup> EPA, 1991b.

TABLE 3-11  
 ROCKY FLATS PLANT  
 RISK ASSESSMENT TEMPLATE  
 EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
 RESIDENTIAL EXPOSURE: DERMAL CONTACT WITH SURFACE WATER  
 AND SEDIMENTS

Intake (mg/kg-day) = $\frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration (mg/L)	Site specific	Site specific
SA	= Surface area (cm <sup>2</sup> )	19,400	19,400
PC	= Permeability constant (cm/hour) <sup>(1)</sup>	8.0E-04	8.0E-04
ET	= Exposure time (hours/event) <sup>(2)</sup>	2.6	2.6
EF	= Exposure frequency (events/year) <sup>(2)</sup>	21	7
ED	= Exposure duration (year) <sup>(2)</sup>	30	9
CF	= Conversion factor (L/cm <sup>3</sup> )	10 <sup>-3</sup>	10 <sup>-3</sup>
BW	= Body weight (kg) <sup>(2)</sup>	70	70
AT	= Averaging time (days) <sup>(2)</sup>		
	Noncarcinogenic	10,950	3,285
	Carcinogenic	25,550	25,550

<sup>(1)</sup> The permeability constant of water is used, but chemical-specific permeability constants should be used when available for aqueous solutions.

<sup>(2)</sup> EPA, 1991b.



TABLE 3-16  
ROCKY FLATS PLANT  
RISK ASSESSMENT TEMPLATE  
EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
RESIDENTIAL EXPOSURE: INCIDENTAL INGESTION OF SURFACE  
WATER AND SEDIMENT WHILE SWIMMING

Intake (mg/kg-day) = $\frac{C \times IR \times ET \times EF \times ED \times CF}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration (mg/L)	Site specific	Site specific
IR	= Intake rate (ml/hr) <sup>(1)</sup>	50	50
ET	= Exposure time (hours/event) <sup>(1)</sup>	2.6	2.6
EF	= Exposure frequency (events/year) <sup>(1)</sup>	21	7
ED	= Exposure duration (years) <sup>(1)</sup>	30	9
CF	= Conversion factor (L/ml)	10 <sup>-3</sup>	10 <sup>-3</sup>
BW	= Body weight (kg) <sup>(1)</sup>	70	70
AT	= Averaging time (days)	10,950	3,285
	Noncarcinogenic	25,550	25,550
	Carcinogenic		

<sup>(1)</sup> EPA 1991b.

TABLE 3-18  
 ROCKY FLATS PLANT  
 RISK ASSESSMENT TEMPLATE  
 EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
 RESIDENTIAL EXPOSURE: INGESTION OF LOCALLY CAUGHT FISH

Intake (mg/kg-day) = $\frac{C \times FI \times IR \times EF \times ED}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration in fish (mg/kg)	Site specific	Site specific
FI	= Fraction ingested	Site specific	Site Specific
IR	= Ingestion rate (kg/meal)	0.28	0.11
EF	= Exposure frequency (meals/year)	48	48
ED	= Exposure duration (years)	30	9
BW	= Body weight (kg)	70	70
AT	= Averaging time (days)		
	Noncarcinogenic	10,950	3,285
	Carcinogenic	25,550	25,550

TABLE 3-30  
ROCKY FLATS PLANT  
RISK ASSESSMENT TEMPLATE  
EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
RECREATIONAL EXPOSURE: DERMAL CONTACT WITH SURFACE WATER  
AND SEDIMENTS

Intake (mg/kg-day) = $\frac{C \times SA \times PC \times ET \times EF \times ED \times CF}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration (mg/L)	Site specific	Site specific
SA	= Surface area (cm <sup>2</sup> )	19,400	19,400
PC	= Permeability constant (cm/hr) <sup>(1)</sup>	8.0E-04	8.0E-04
ET	= Exposure time (hr/event)	2.6	2.6
EF	= Exposure frequency (events/year) <sup>(2)</sup>	21	7
ED	= Exposure duration (year) <sup>(2)</sup>	30	9
CF	= Conversion factor (L/cm <sup>3</sup> )	10 <sup>-3</sup>	10 <sup>-3</sup>
BW	= Body weight (kg) <sup>(2)</sup>	70	70
AT	= Averaging time (days) <sup>(2)</sup>		
	Noncarcinogenic	10,950	3,285
	Carcinogenic	25,550	25,550

<sup>(1)</sup> The permeability constant of water is used, but chemical-specific permeability constants should be used when available for aqueous solutions.

<sup>(2)</sup> EPA, 1991b.

ADMIN RECORD

TABLE 3-32  
ROCKY FLATS PLANT  
RISK ASSESSMENT TEMPLATE  
EXPOSURE PARAMETERS AND INTAKE ALGORITHM  
RECREATIONAL EXPOSURE: INGESTION OF LOCALLY CAUGHT FISH

Intake (mg/kg-day) = $\frac{C \times FI \times IR \times EF \times ED}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration in fish (mg/kg)	Site specific	Site specific
FI	= Fraction ingested	Site specific	Site specific
IR	= Ingestion rate (kg/meal) <sup>(1)</sup>	0.284	0.113
EF	= Exposure frequency (meals/year) <sup>(1)</sup>	48	48
ED	= Exposure duration (years) <sup>(1)</sup>	30	9
BW	= Body weight (kg) <sup>(1)</sup>	70	70
AT	= Averaging time (days)		
	Noncarcinogenic	10,950	3,285
	Carcinogenic	25,550	25,550

<sup>(1)</sup> EPA, 1989

Table 3-33

ROCKY FLATS PLANT AREA WIDE  
RISK ASSESSMENT TEMPLATE  
EXPOSURE PARAMETERS AND CALCULATIONS  
RECREATIONAL EXPOSURE: INCIDENTAL INGESTION OF SURFACE WATER  
AND SEDIMENTS WHILE SWIMMING

Intake Factor = $\frac{C \times CR \times EV \times EF \times ED}{BW \times AT}$			
Parameter		RME	AVG
C	= Chemical concentration (mg/L)	Site specific	Site specific
CR	= Consumption rate of water (ml/hour)	50	50
EV	= Event duration (hr/event)	2.7	2.7
EF	= Exposure frequency (days/year)	7	7
ED	= Exposure duration (years)	30	9
BW	= Body weight (kg)	70	70
AT	= Averaging time (days)		
	Noncarcinogenic	10,950	3,285
	Carcinogenic	25,550	25,550

Rocky Flats Plant